

# APPLE-PROCESSING POSSIBILITIES IN VERMONT

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Processing plays a vital role in the utilization of apples. In an average year, such as 1944 or 1946, approximately 40 million bushels, or about one-third of the annual crop, is used in the manufacture of a wide variety of food and industrial products (Table I).

TABLE I. Disposition of Apple Crop by Outlets<sup>1</sup>

	Crop Year				
	1937-42 Average	1944	1945	1946	1947
	(in million bushels)				
Total crop .....	126.4	121.3	66.8	119.4	112.5
Total processed .....	29.7	38.0	22.1	42.8	....
Non-commercial usage .....	7.1	6.1	2.9	5.6	5.5
Not utilized .....	7.7	2.2	0.0	0.8	2.4
Exports .....	4.9	1.3	1.3	5.2	2.2
Assumed fresh use .....	77.0	73.7	40.5	65.0	....

<sup>1</sup> Data from National Apple Institute. Revised July, 1947.

The utilization of cull grades or surplus fruit benefits the apple industry in several ways: It encourages closer grading, thus helping to maintain the quality and price of fruit for fresh use; it provides a profitable outlet

TABLE II. Percentage of Commercial Apple Crop Processed in Various States in 1944<sup>1</sup>

State	Total Commercial Production	Total Processed	Percent Processed
	1,000 bu.	1,000 bu.	
New England States .....	6,741	972	14.4
New York .....	17,010	6,705	39.4
Pennsylvania .....	9,100	4,150	45.6
Virginia .....	14,580	5,947	40.8
West Virginia .....	4,356	2,173	49.9
Michigan .....	7,625	2,200	28.9
Washington .....	31,100	5,300	17.0
Oregon .....	3,432	849	24.7
California .....	6,144	3,190	51.9
Other States .....	24,666	3,989	16.2
Total (35 states) .....	124,754	35,425	28.4

<sup>1</sup> Data from U. S. Department of Agriculture, Bureau of Agricultural Economics.

for culls and surplus fruit; it increases the total demand for apples; and it helps to stabilize the market during periods of economic depression or seasons of over-production.

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The percentage of the crop processed in various states or regions in 1944 is shown in Table II. In some states nearly one-half of the total production is utilized by processing plants. This is especially true of California and the Shenandoah-Appalachian area, where certain varieties are grown specifically for this purpose. In the Pacific Northwest apples are grown almost exclusively for fresh use, and only the secondary grades are diverted to processed products. The New England States rank lowest, only 14.4 per cent of the crop being used in processing. The proportion of the crop utilized in processed products in Vermont is probably negligible, since there are no apple processing plants within the State.

This brings us to the crux of the present discussion, namely, what are the possibilities of establishing a processing industry in Vermont? There are several factors to be considered in determining the prospects for an enterprise of this kind—the quantity of fruit available, the varieties grown and their suitability for various products, storage facilities, and potential market outlets. The entire problem of utilizing cull apples is not peculiar to this State, but applies equally well to other apple-producing areas which at present have no processing facilities.

### Quantity and Varieties Available

It is necessary to consider the volume of fruit available and the suitability of the different varieties for making different types of processed products. The average commercial production of apples in Vermont for the 10-year-period 1934-43 was 561,000 bushels per year (National Apple Institute Bulletin 211). Assuming that 30 per cent of the crop would be available for processing, the average yearly supply would be about 170,000 bushels. This is only an average, however; the volume of fruit for processing will fluctuate from season to season. When there is a short crop there will be a smaller percentage of culls, and with a bumper crop there will be a larger proportion of culls and probably large quantities of surplus fruit to be processed. Any plans concerning the kinds of products to prepare and the size of plant required should have sufficient flexibility to provide for reasonable fluctuations in supply of fruit.

Lacking more specific data, I shall assume that the varieties of apples grown in Vermont are the same as those reported for the entire New England area. According to statistics published by the Bureau of Agricultural Economics, the leading apple varieties grown in New England in 1947 were McIntosh (48 per cent of total crop), Baldwin (21 per cent), Cortland (5 per cent), Delicious (5 per cent), and Northern Spy (4 per cent). All other varieties amounted to 17 per cent. McIntosh and Baldwin are rich in flavor and when blended with other varieties make excellent juice products. Baldwin and Cortland are excellent varieties for freezing or baking. McIntosh is also suitable for freezing or baking in pies if firming with a suitable concentration of calcium salt.

### Selection of Products to Manufacture

In choosing the product or products to manufacture in a new enterprise, it would be well to start with a few products which are easily prepared

# APPLE PRODUCTS

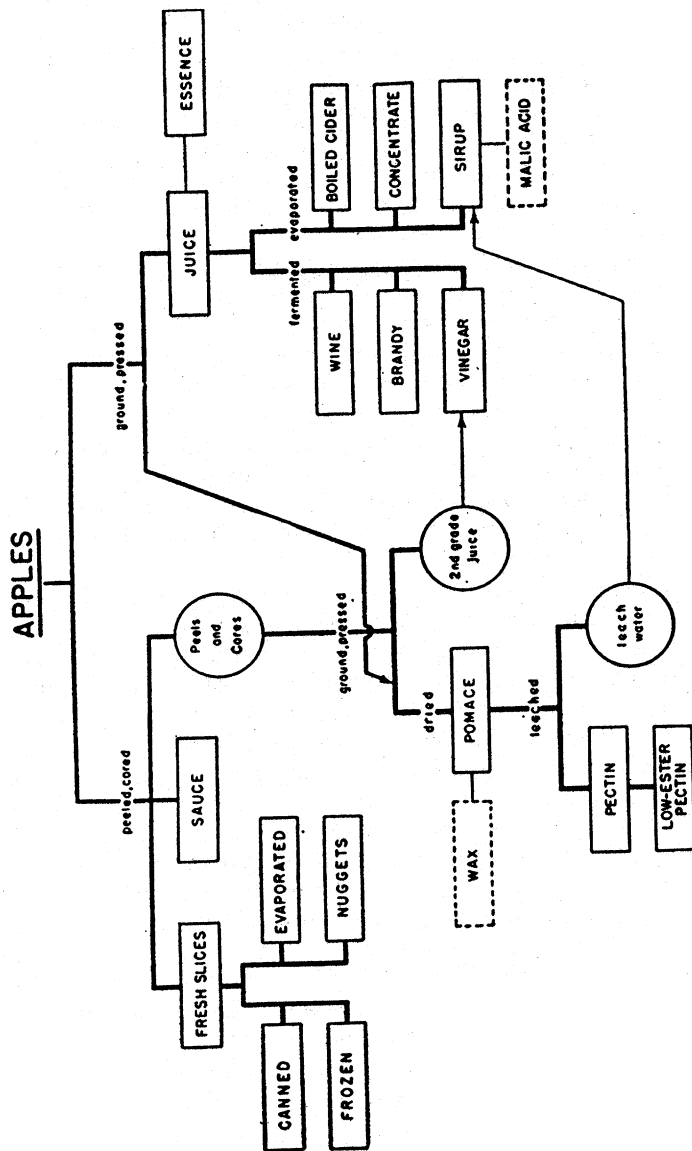


FIGURE 1

with a minimum outlay of equipment. Figure 1 lists 17 primary apple products, plus two potential ones (dotted rectangles), which can be prepared commercially from apples. In addition, there are several products, such as apple jelly, apple butter, candy, and mincemeat, which are derived from one or more of the primary products.

Apple products may be conveniently divided into three groups: (1) Those which utilize the flesh, such as fresh, canned, or frozen slices, sauce, and various dehydrated products; (2) those which use the expressed juice, such as pasteurized juice, sirup, concentrates, and various fermented products, including vinegar; and (3) products derived from waste materials, such as pomace, peels, and cores.

The first group of products is prepared from utility-grade apples, that is, fruit relatively free of defects and larger than  $2\frac{1}{4}$  inches in diameter. The second group is prepared by grinding and expressing the juice, hence size is not a consideration. The third group consists of by-products derived from waste materials of both the other groups. It would be advisable to divide the cull fruit into utility and juice grades in order to realize the maximum financial return. Although juice products may be prepared from utility grade fruit, it would not be economical. The price paid for utility-grade apples in October 1947 was \$2.00 to \$3.00 per hundredweight, but the price of juice-grade apples was only \$0.50 to \$0.90 per hundredweight (National Apple Institute Bulletin No. 273).

Of the various products which a small processing plant might prepare from utility-grade fruit, probably the simplest and easiest to make would be fresh slices for the pie trade. This would depend on a nearby market because the fresh product should be delivered daily, although with suitable refrigeration, fresh apple slices may be stored for several days. Since there are no large urban centers in or near Vermont, the market for fresh slices may not be large enough to utilize all the utility-grade apples. A product which could supplement fresh slices and which would require little additional equipment would be frozen slices. The flow sheet for the production of canned apple slices (Fig. 2) may be helpful in following the procedure for preparing fresh or frozen slices. The initial steps are the same—washing, peeling, trimming and slicing. This is followed by a five or ten minute dip in a one or two per cent salt brine to prevent oxidation and discoloration during subsequent operations. In preparing fresh slices, the apple segments after passing through the brine tank are drained, inspected, and weighed into suitable containers. The slices are usually delivered to the bakery at the end of the day for baking the following day. Where state regulations permit, it is advisable to include a few ounces of a sulfite salt in the brine mixture, since this produces whiter slices and gives longer protection against discoloration.

Frozen slices are prepared in much the same way as fresh slices, except that more rigid treatment to prevent discoloration is required. The following procedures have been used commercially to prevent browning of frozen slices: Steam or hot-water blanching, dipping in a solution of sulfur dioxide or sulfites, evacuation and impregnation with salt brine or ascorbic acid solution, and covering with a mixture of dry sugar and ascorbic acid.

Blanching and sulfuring, the two most commonly used procedures, are adequately described in all standard texts on fruit preservation. Since freezing and thawing tends to soften apple tissues, it is advisable to apply suitable concentrations of calcium chloride to maintain the desired firmness.

The production of both fresh and frozen apple slices would be an ideal arrangement for a small processing plant. The plant could operate during the fall and winter, supplying fresh slices daily to bakeries and at the same time preparing sufficient quantities of frozen slices to supply the same customers during the spring and summer. Any surplus of frozen slices could be sold elsewhere.

Apples which are too small to be peeled economically may be used in apple butter or various juice products. The simplest products to prepare, other than fresh cider, are pasteurized juice and apple concentrate. Apple butter is another product which is often prepared and marketed successfully by small operators, especially if they can develop a specialty product for local trade.

## PRODUCTION OF CANNED APPLE SLICES

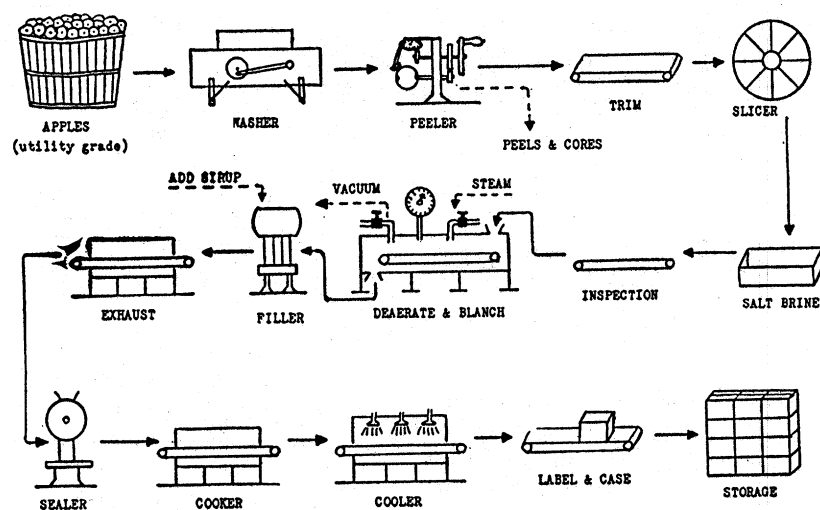


FIGURE 2

The flow sheet for manufacture of apple juice is shown in Figure 3. For a more detailed description of the procedures used commercially, the reader is referred to the recent Circular Bulletin No. 206 by Dr. Roy E. Marshall, Michigan State College, entitled "Apple Juice, Preparation and Preservation."

Apple juice is usually prepared from a blend of several varieties. The size of the fruit is not important, but it should be mature and properly ripened. Only clean, sound fruit should be used, and it should be washed before grinding. The expressed juice may be treated in various ways before it is pasteurized and packaged. Procedures such as filtration or centrifugation produce cloudy juices. Clarified juices may be prepared by Pectinol,<sup>2</sup> gelatin-tannin, or heat treatments followed by filtration. Both clarified and nonclarified juices are sold commercially and there appears to be no distinct trend toward one in preference to the other. The importance of promptly cooling the filled containers cannot be overemphasized. Apple juice like other food products deteriorates rapidly if stored at warm temperatures. Juice should be stored at a temperature of 50° F. or

## PRODUCTION OF APPLE JUICE

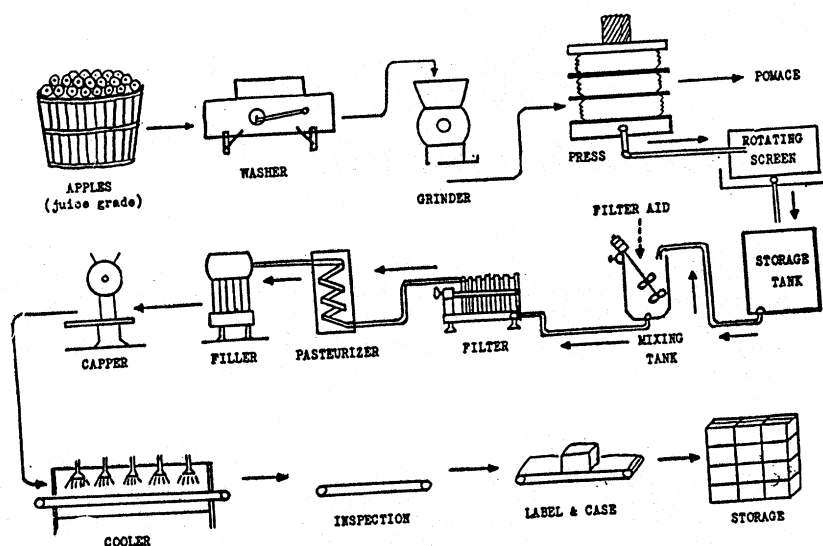


FIGURE 3

below if possible. The demand for apple juice has not kept pace with production during the past two seasons. This may be due in part to competition from citrus juices, but there is reason to believe that a high-quality product will find a profitable market.

Apple concentrate is another product which could be prepared in a small plant. For this product the juice is usually clarified, although for some purposes a cloudy concentrate may be used. The next step is to evaporate the juice in a vacuum pan to a high soluble-solids concentration. Clarified juice may be concentrated to about 70 per cent soluble solids, but a non-

<sup>2</sup> In giving the trade-names mentioned in this publication, the Bureau of Agricultural and Industrial Chemistry, United States Department of Agriculture, does not in any way guarantee these products nor are they recommended in preference to others not mentioned.

clarified juice, because of its pectin content, usually gels when concentrated to 55 per cent soluble solids or above. Apple concentrate may be stored and used in various products such as apple jelly, apple butter, and apple candy. This latter product should be considered for a small-scale operation, although it is a specialty product and would require time to develop a sizable market.

TABLE III. Quantity of Slices Obtained From Various Sizes of Apples<sup>1</sup>

Size	Yield from 100 Pounds of Apples
Inches	Pounds
2-1/4 .....	53
2-1/2 .....	66
2-3/4 .....	73
3 .....	78

<sup>1</sup> Data from National Apple Institute, Bull. No. 248.

TABLE IV. Yields of Juice and Pomace from One Ton of Apples

	Single Pressed	Double Pressed
Yield of juice, gallons .....	160	175
Wet pomace, pounds .....	600	470
Average moisture of pomace, per cent .....	69.0	63.5
Yield of dry pomace (7% moisture basis), pounds ...	200	185
1 gallon juice (12.0 Brix) = 8.75 pounds.		

### Waste Utilization

Assuming that a processing plant will grade the cull and surplus fruit into utility and juice grades, and prepare one or more products from each, what will be the estimated volume of waste peels, cores, and pomace? Table IV shows the average quantities of juice, wet pomace and dry pomace obtained from one ton of apples. Second pressing may yield an additional 15 gallons of juice but this is not suitable for cider or pasteurized juice. It may be used for concentrate or vinegar manufacture. Each ton of utility-grade apples will yield about one-third ton of peels and cores (Table IV) which, when ground and pressed, would give about the same proportion of juice and pomace as whole apples. This juice is not suitable for cider or pasteurized juice but may be utilized in concentrate or vinegar.

It is doubtful whether drying pomace in a small plant would be profitable. It would be necessary to estimate the volume of processing waste available, the relative costs of labor and fuel and the market price of dried pomace and expressed juice. Many processing plants realize little or no profit from drying pomace, but it eliminates a more costly problem of disposing of large quantities of wet pomace. For a small plant it may be advisable at first to dispose of waste pomace and peels and cores for cattle feed.

## Summary

Processed apple products provide a profitable outlet for cull and surplus fruit. Apples to be processed should be graded into two groups, utility and juice grades, and one or more products prepared from each group. A small processing plant should prepare the products which are adaptable to a small volume of production, a variable supply, and a minimum of equipment.

Fresh or frozen slices are suitable products to prepare from utility-grade fruit, and cider, juice, and concentrate are suitable products for juice-grade apples. Specialty products such as apple butter, jelly, and apple candy may be prepared as supplementary items. Drying the pomace should be considered as a means of utilizing processing wastes.

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